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One New Species and One Unrecorded Species of the Genus *Coleophora* (Lepidoptera, Coleophoridae) from Korea

Jun-Mo Koo[1], Giorgio Baldizzone[2], Jae-Dong Kim[3], Kyu-Tek Park[4], Soowon Cho[1,*]

[1]Insect Systematic Bioinformatics Laboratory, Department of Plant Medicine, Chungbuk National University, Cheongju 28644, Korea
[2]Via Manzoni, 24, I-14100 Asti, Italy
[3]Department of Applied Biology, College of Agriculture and Life Science, Chungnam National University, Daejeon 34134, Korea
[4]Bioresource and Environmental Center, Incheon National University, Incheon 22012, Korea

ABSTRACT

Family Coleophoridae, commonly known as "casebearers", is one of the largest families of Gelechioidea (Lepidoptera), with more than 1,450 described species worldwide, but it has been poorly known in Korea, with only 32 known species of the genus *Coleophora* Hübner, 1822. Here we present *Coleophora fasciella* Koo & Baldizzone, sp. nov., a new species to science, and *C. mayrella* (Hübner, [1813]), an unrecorded species in Korea. Diagnostic characteristics with descriptions of the genitalia are provided with photos of adults, wing venations, and genitalia of both sexes for the species. Mitochondrial cytochrome *c* oxidase subunit I (*COI*) barcode sequences for the two species are also provided.

Keywords: *mayrella*, *fasciella*, new record, new species, Korean fauna

INTRODUCTION

Coleophorids, known as "casebearers", belong to Gelechioidea (Lepidoptera) and comprise more than 1,450 described species worldwide, and about 1,184 species of the total have been known in the Holarctic region. The common name "casebearers" comes from larval building behavior, and many species of coleophorids build a larval shelter with seeds, buds, silk and/or leaf material. Most of coleophorid larvae are leaf or seed miners, and only a few species feed on leaves externally (Baldizzone et al., 2006; Kim and Park, 2009; Bauer et al., 2012).

The family had been restricted to five genera, *Augasma* Herrich-Schäffer, 1853, *Coleophora* Hübner, 1822, *Goniodoma* Zeller, 1849, *Ischnophanes* Meyrick, 1891 and *Metriotes* Herrich-Schäffer, 1853 (Baldizzone et al., 2006), but two genera, *Goniodoma* and *Metriotes*, were nested within *Coleophora* by Bauer et al. (2012). The taxonomy of the genus level of Coleophoridae is still unstable and continues to be discussed with complicated species identification (Bauer et al., 2012; Anikin et al., 2016a, 2016b).

In adjacent territories of the Korean peninsula, 104 species of *Coleophora* from China (Baldizzone et al., 2006), 57 species of *Coleophora* from the Russian Far East (Baldizzone and Savenkov, 2002; Baldizzone et al., 2006), and at least 80 species of *Coleophora* from Japan (Kusunoki and Oku, 2012, 2013, 2015; Oku, 2013; Junbo and Suzuki, 2018; Oku and Kusunoki, 2018) have been known. However, this genus is one of the poorly known groups of Microlepidoptera in Korea, with only 32 known species (Kim and Park, 2009; Park, 2014).

As an initiative study for our long-term project on Coleophoridae, we report one new species, C. *fasciella* Koo & Baldizzone, sp. nov., and one unrecorded species, *C. mayrella* (Hübner, [1813]), in Korea. Cytochrome *c* oxidase subunit I (*COI*) barcode sequences are also provided for both species (Appendix 1).

MATERIALS AND METHODS

The present study is based on the specimens collected from

*To whom correspondence should be addressed
Tel: 82-43-261-2558, Fax: 82-43-271-4414
E-mail: chosoowon@gmail.com

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the central part of the Korean peninsula and Gageodo, a southwestern island of Korea, during recent years. Forewing length was measured from the base of the forewing to the apex including the fringe. Images of adult were taken using Olympus OM-D E-M1 (Olympus Corp., Japan) and those of genitalia were taken using Olympus SZX16 (Olympus Corp.) equipped with Canon EOS 600D (Canon Inc., Japan). Genitalia were stained with chlorazol black and mercurochrome, and wings were stained in a saturated solution of the double stain, which contains lignin pink, acid fuchsin, glacial acetic acid, lactic acid and phenol, for 30 min. Both were slide-mounted in Euparal. The colour standard for the description of adults followed Kornerup and Wanscher (1978). Morphological terminology followed Baldizzone (2019). Mitochondrial DNA was extracted using DNeasy Blood & Tissue Kit (Qiagen, Germany). PCR was conducted using Takara PCR Thermal Cycler Dice TP600 (Takara Bio Inc., Japan) with LCO-1490 and HCO-2198 as a primer set and 2×Uh-taq PCR Pre-Mix (SolGent Co., Ltd., Korea) to get *COI* barcode sequence of mitochondrial DNA. The *COI* sequences (658 bp) were identified via the GenBank and the BOLD Systems (Barcode of Life Data System). All the type specimens are deposited in the Department of Plant Medicine, Chungbuk National University (CBNU), Korea.

SYSTEMATIC ACCOUNTS

Order Lepidoptera Linnaeus, 1758
Family Coleophoridae Hübner, [1825]
Genus *Coleophora* Hübner, 1822

Coleophora Hübner, 1822: 66–80. Type species: *Tinea anatipennella* Hübner, 1796. Synonymy details: See Baldizzone et al. (2006), and Baldizzone (2019).

[1]*_Coleophora fasciella_ Koo & Baldizzone, sp. nov. (Figs. 1A–E, 2A–F)

LSID: urn:lsid:zoobank.org:pub:7C39AA15-B260-4D82-8AD6-ADE75D4A9F4D

Types. Holotype: Korea: 1♂, Jeonnam Prov.: Sinan-gun, Heuksan-myeon, Gageodo [Island], 34°03′48.40″N, 125°07′20.70″E, 23 Sep 2018, coll. Kim JD, Kim M; gen. slide no. KJM_0114; sequence no. CBNU203.

Paratypes: Korea: 3♀♀, Jeonnam Prov.: Sinan-gun, Heuksan-myeon, Gageodo [Island], 34°03′48.40″N, 125°07′20.70″E, 23 Sep 2018, coll. Kim JD, Kim M; gen. slide nos. KJM_0113, 0118; wing slide no. KJM_0116 (♀); sequence nos. CBNU202, CBNU204, CBNU225.

Diagnosis. The species is similar to *Coleophora artemisicolella* Bruand, 1855 and *C. falkovitshella* Vives, 1984, but it can be distinguished by the smaller tooth at the tip of each juxta rods, and the smaller tooth-shaped folds on sacculus when compared to *C. artemisicolella* and *C. falkovitshella*. *Coleophora fasciella* sp. nov. also has more pointed, horn-like protuberance in dorsal corner of the sacculus than *C. artemisicolella* in male genitalia, and has narrower sterigma, longer colliculum and not spinulated part of the ductus bursae on distal half, longer and narrower spinulate section, and more globular corpus bursae than *C. falkovitshella* in female genitalia.

In COI barcodes, we obtained the barcode sequences from four specimens of the new species (GenBank accession nos.: MT394458, MT394459, MT394460, and MT394461). The barcode sequences of the new species and Korean *C. artimisicolella* (GenBank accession no.: KF523760.1) showed 1.4–1.7% in p-distance. The Korean *C. artemisicolella* has never been formally reported in Korea, but its barcode sequence was used as a part of the data in Sohn et al. (2016). The COI barcode sequence of *C. falkovitshella* was not available in GenBank and BOLD Systems, but the morphological differences on both sexes of genitalia are considerable for a specific distinction.

Description. Adult of both sexes (Fig. 1A–E). Forewing length 4.5–5 mm.

Head: Vertex brownish orange, suffused on sides with yellowish white. Antenna slender, shorter than forewing, about 0.7 times; basal segment yellowish white with dark brown erect scales ventrally on outer surface; flagellum yellowish white ringed with brownish orange, slightly paler medially, then brownish orange rings getting darker gradually from beyond basal 2/3. Labial palpus yellowish white with dark brown streak on outer surface of 2nd segment diagonally; 2nd segment dark brown ventrally on inner surface in male (Fig. 1B), brownish orange in female (Fig. 1D); 3rd segment shorter than 2nd segment, about 0.6 times, dark brown ventrally in male, brownish orange entirely, upturned in female (Fig. 1B, D).

Thorax: Thorax yellowish white entirely with faint brownish-orange scales along anterior margin of tegula. Forewing yellowish white with brownish orange longitudinally mostly along veins, and with scattered dark brown scales sparsely; costa slightly arched in basal 3/5; costal fringe yellowish white in basal 2/3, then gradually darker toward apex; apical fringe brownish orange, dorsal fringe brownish grey; venation (Fig. 1E) with R_1 arising from basal 2/5 of discal cell; distance between origins of R_1 and R_2 nearly same as that of R_2 and R_3; R_{4+5} reaching before apex; R_{4+5} and M_1 short-

Korean name: [1]*후추가루날개통나방 (신칭)

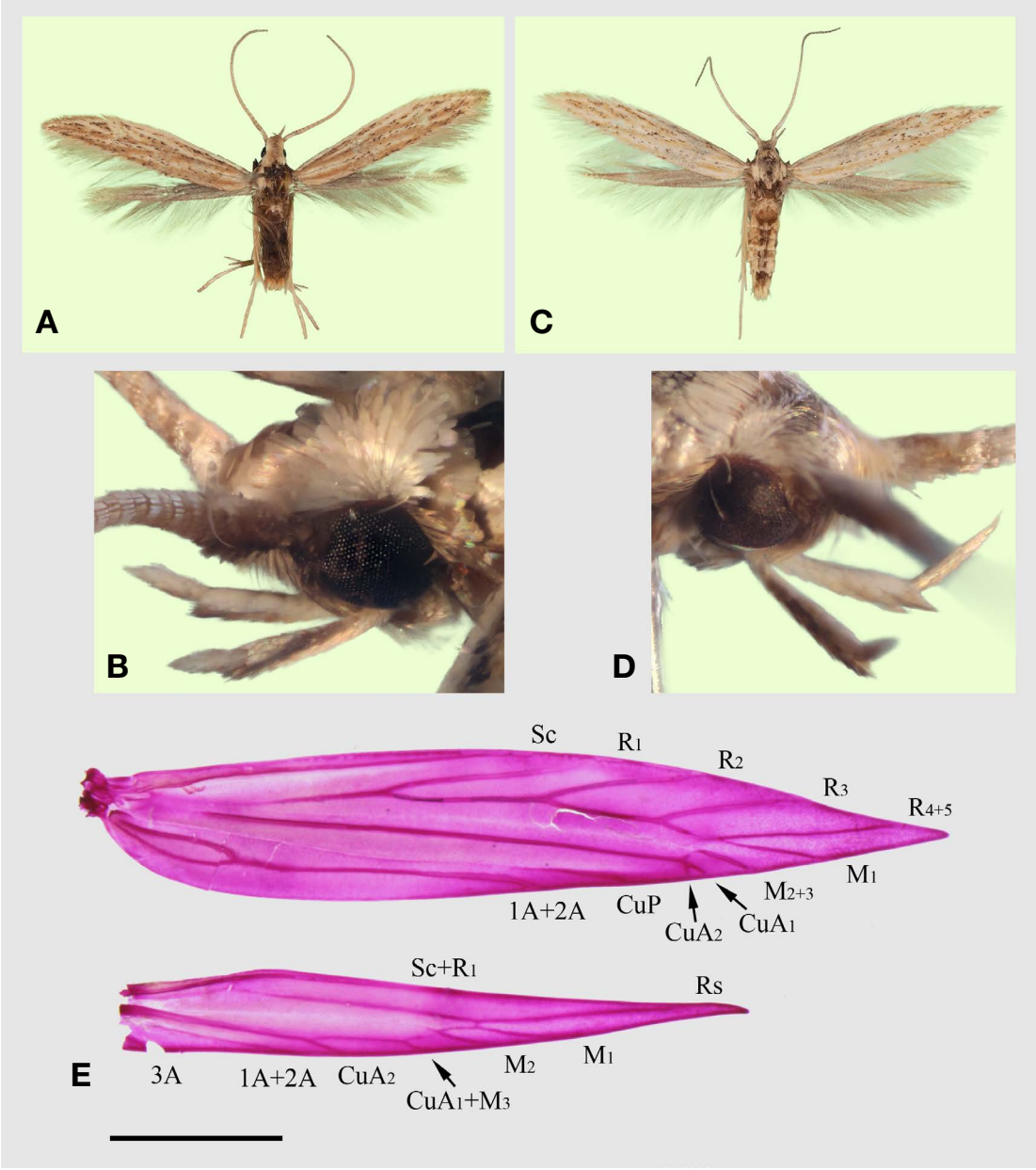

Fig. 1. Adults of *Coleophora fasciella* Koo & Baldizzone, sp. nov. A, Holotype, male adult; B, Labial palpi of male, outer surface & inner surface; C, Paratype, female adult; D, Labial palpi of female, outer surface & inner surface; E, Wing venation, wing slide no. KJM_0116 (♀). Scale bar: E = 1.0 mm.

stalked at base; CuA_1 and CuA_2 short-stalked, arising from lower corner of discal cell; 1A + 2A forked for 1/3 at base; discal cell open. Hind wing brownish grey with brownish-grey fringe; costa slightly bent near basal 1/4; Rs reaching before apex; discal cell closed.

Abdomen: Abdomen yellowish white with brownish-orange scales.

Note: There is a notable variation in colour brightness: slightly lighter or darker on adult specimens.

Male genitalia (Fig. 2A, B): Gnathos knob suborbicular. Tegumen constricted medially; pedunculus dilated outwardly. Transtilla slightly curved postero-medially, with rounded apex. Valvula small, not very evident, slightly convex dorsally near base of costa. Cucullus (Fig. 2A; damaged) elliptical in distal part, with rounded apex, bearing numerous upward setae. Sacculus sclerotized with a upwardly curved,

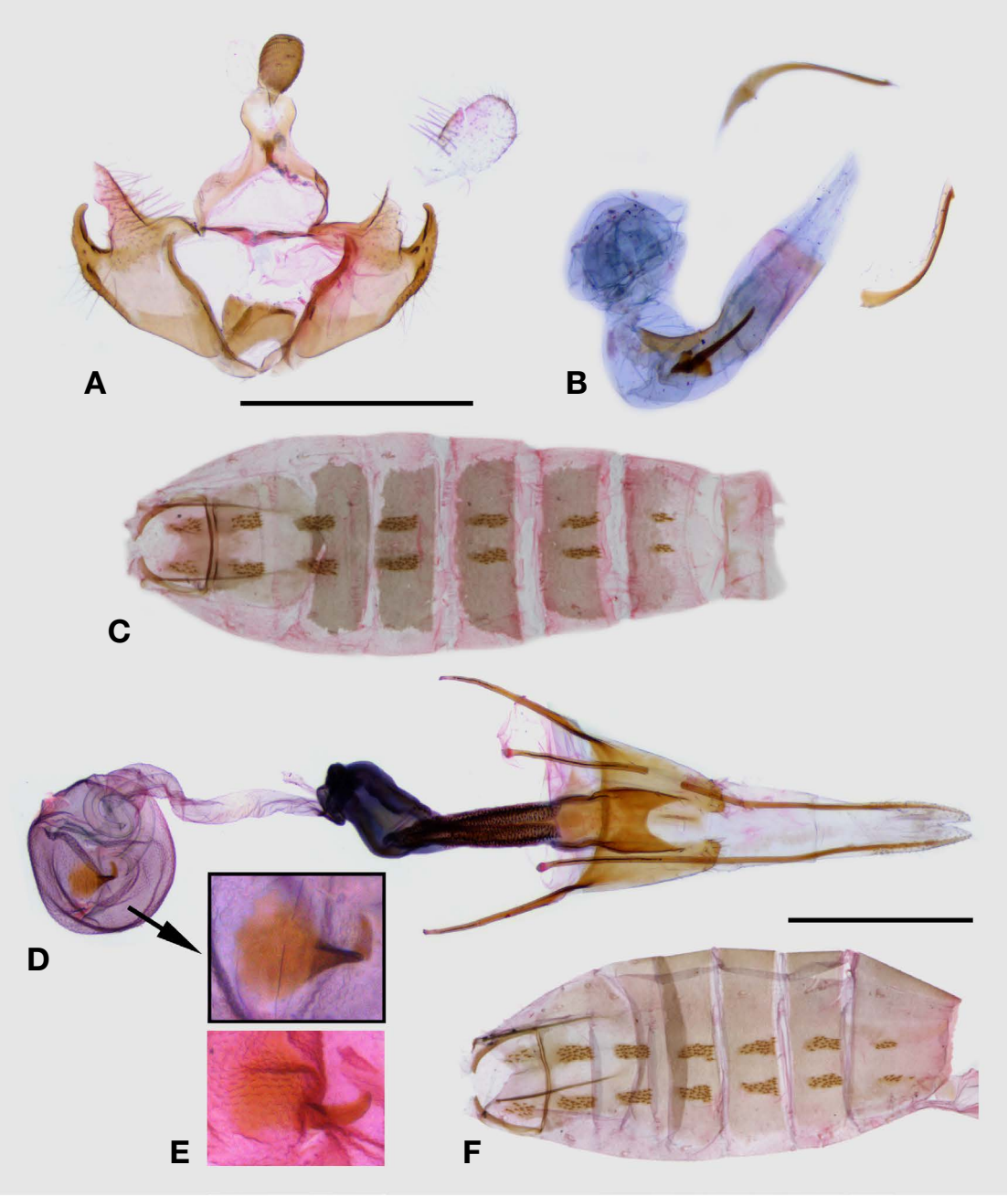

Fig. 2. Genitalia of *Coleophora fasciella* Koo & Baldizzone, sp. nov. A, Holotype, male genitalia, gen. slide no. KJM_0114; B, Phallus; C, Male abdomen; D, Paratype, female genitalia, gen. slide no. KJM_0113; E, Paratype, close-up signum, gen. slide no. KJM_0118; F, Female abdomen. Scale bars: A, F = 0.5 mm.

horn-like, prominent protuberance distally and small tooth-like folds before protuberance. Phallotheca long with two sclerotized thin juxta rods (Fig. 2B; damaged) consisting a triangular tooth on each subapical part. Aedeagus stout, bent before middle. Cornutus needle-shaped, heavily sclerotized.

Abdominal structures (Fig. 2C, F): No posterior lateral struts. Transverse strut slightly bent medially, slender in female, with darkly sclerotized anterior and posterior margin. Tergal disks (3rd tergite) about 2 times longer than the width, covered with 21–30 conical spines on each patch.

Female genitalia (Fig. 2D, E): Papillae anales narrow. Apophyses posteriores about 2.4 times longer than apoph-

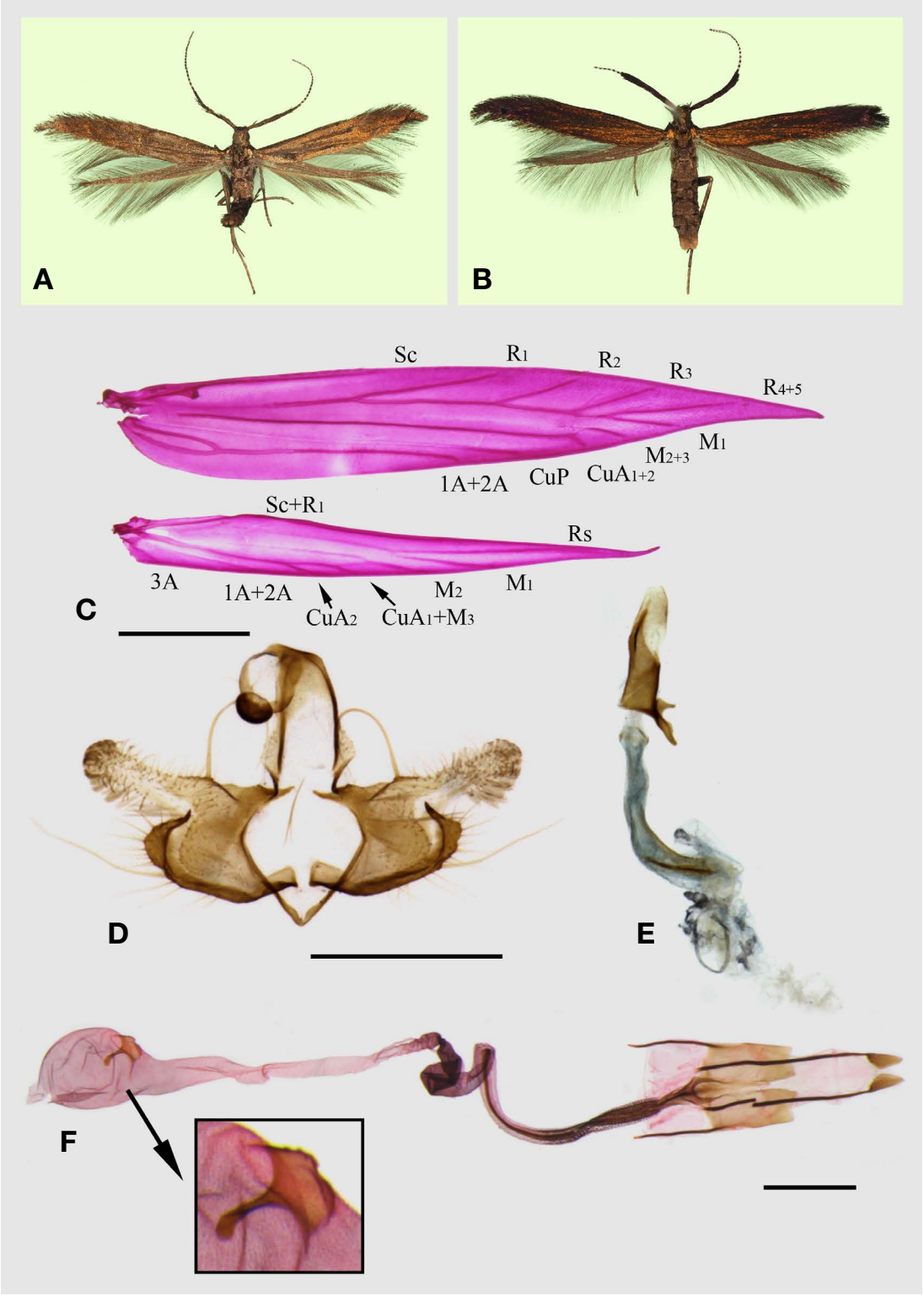

Fig. 3. *Coleophora mayrella* (Hübner, [1813]). A, Male adult; B, Female adult, C, Wing venation, wing slide no. KJM_0115 (♂); D, Male genitalia, gen. slide no. KJM_0048; E, Phallus; F, Female genitalia, close-up signum, gen. slide no. KJM_0117. Scale bars: C = 1.0 mm, D, F = 0.5 mm.

yses anteriores. Ostium bursae deeply concave medially, U-shaped. Sterigma subtrapezoidal. Colliculum medially constricted. Ductus bursae about 2.5 times longer than the length of corpus bursae, with spinulate section in posterior 1/3, broadened medially, and narrowed in anterior 2/5. Corpus bursae globular. Signum plate with a small, thorn-like process strongly bent medially.

Host plants. Unknown.

Distribution. South Korea (Gageodo [Is.]).

Etymology. The specific epithet is derived from the Latin, *fascia* (= streak), referring to the dark-brown streak on outer surface of the 2nd segment of labial palpus.

[1]***Coleophora mayrella* (Hübner, [1813]) (Fig. 3A–F)**

Phalaena (*Tinea*) *fabriciella* Villers, 1789: 527. Junior primary homonym of *Phalaena Tinea fabriciella* Swederus, 1787: 277.

Tinea mayrella Hübner, [1813]: 4, Pl. 47, fig. 322. Type locality: Europe.

Porrectaria spissicornis Haworth, 1828: 537.

Ornix trochilipennella Costa, 1836: 296, Pl. 3, fig. 6.

Coleophora coruscipennella Clemens, 1860: 4.

Coleophora aeneusella Chambers, 1874: 128.

Coleophora auropurpuriella Chambers, 1874: 130.

Coleophora tuscaemiliella Costantini, 1923: 69.

Damophila moldaviella Nemeş, 2004: 9.

Coleophora mayrella; Vives, 1988: 93; Landry & Wright, 1993: 570; Hoare, 2001: 46; Baldizzone & Savenkov, 2002: 369; Baldizzone, Wolf & Landry, 2006: 80; Stübner, 2007: 152; Oku, 2013: 237; Baldizzone, 2019: 130.

Material examined. Korea: 3♂♂, Gyeongbuk Prov.: Cheongsong-gun, Budong-myeon, 15 May 2017, coll. Lim EJ; gen. slide nos. KJM_0047, KJM_0048; 2♂♂, Chungbuk Prov.: Cheongju-si, Gaesin-dong, 36°37′42.92″N,127°27′03.25″E, 10 May 2017, coll. Koo JM; gen. slide no. KJM_0043, KJM_0046; wing slide no. KJM_0115; 4♂♂, Chungbuk Prov.: Jecheon-si, Hansu-myeon, 36°52′07.10″N, 128°05′12.10″E, 21–22 May 2019, coll. Koo JM, Lim EJ; sequence no. CBNU200, CBNU201; 1♀, Gyeongbuk Prov.: Cheongsong-gun, Budong-myeon, Ijeon-ri, 36.363022, 129.188409, 15 May 2017, coll. Paek MK; gen. slide no. KJM_0117; sequence no. CBNU199; 1♂, Chungbuk Prov.: Cheongwon-gun, Miwon-myeon, Miwon-ri, 16 May 2014, coll. Ahn CK, Yoo JH, Lim EJ; sequence no. CBNU182.

Diagnosis. Forewing length 5–5.5 mm. The species is similar to *C. paramayrella* Nel, 1993, but it can be distinguished by the lengths of the two long thick setae, one on the costa of valva and the other on the margin of sacculus, which are much longer than those of *C. paramayrella*, and by the curved distal margin of sacculus, while nearly right-angled in *C. paramayrella*. It can also be distinguished by the ostium bursae which is well-sclerotized and narrower than *C. paramayrella* in width.

Male genitalia (Fig. 3D, E): Gnathos knob globular. Valvula slightly convex medially on costa, with a long thick seta. Cucullus elongated, narrow, with setae outwardly. Sacculus ventral margin well-sclerotized, distal margin curved inward rather than angled, with a very long seta near basal 2/3 of the ventral margin and shorter setae outwardly along the margin. Phallotheca well-sclerotized with fused juxta rods. Caulis coupled strongly with phallotheca. Cornuti grouped in a row, forming a needle-like bundle. See also Landry and Wright (1993, figs. 28 and 40); Baldizzone (2019, Pl. GM XV, fig. 47).

Female genitalia (Fig. 3F): Papillae anales narrow, sclerotized. Apophyses posteriores about 2.1 times longer than apophyses anteriores. Ostium bursae deeply concave medially and U-shaped. Sterigma elongated rectangular. Colliculum constricted. Ductus bursae long, 4 times or longer than the length of corpus bursae, with spinulate section in basal about 1/4. Signum curved plate-like, roughly in isosceles trapezoidal, with a narrow spatulate, distally curved process at middle of basal edge. See also Landry and Wright (1993, fig. 51); Baldizzone (2019, Pl. GF XVI, fig. 48).

Host plants. Fabaceae: *Trifolium arvense*, *T. pratense*, *T. repens* (Falkovitsh, 2006; De Prins et al., 2019).

Distribution. Europe, North Africa, Turkey, Armenia, Central Asia, Russia Far East, Japan, Canada, U.S.A., Argentina, Chile, Australia, New Zealand, Korea (new record).

ORCID

Jun-Mo Koo: https://orcid.org/0000-0003-2639-6456
Giorgio Baldizzone: https//orcid.org/0000-0001-8127-0843
Jae-Dong Kim: https://orcid.org/0000-0001-5452-2857
Kyu-Tek Park: https://orcid.org/0000-0001-9933-4497
Soowon Cho: https://orcid.org/0000-0001-6085-0064

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

Korean name: [1]*도깨비통나방 (신칭)

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Appendix 1. Cytochrome *c* oxidase subunit I (COI) barcode sequence (658 bp) data for two species of *Coleophora*.

Coleophora fasciella Koo & Baldizzone, sp. nov., holotype, CBNU203 (GenBank accession no. MT394460)

AACATTATATTTCATTTTTGGAATTTGAGCTGGAATAGTAGGAACTTCTTTAAGTTTATTAATTCGAGCTGAATTAGGAAACCCTGGATCATTA
ATTGGTGATGATCAAATTTATAATACAATTGTTACAGCCCATGCTTTTATCATAATTTTCTTTATGGTAATACCTATTATAATTGGAGGGTTTG
GAAATTGATTAGTACCTTTAATACTAGGAGCCCCTGATATAGCTTTCCCCCGAATAAATAATATAAGATTTTGACTTCTCCCCCCATCATTA
ACTCTTTTAATTTCAAGAAGAATTGTAGAAAATGGTACTGGAACTGGATGAACAGTTTACCCCCCTTTATCATCTAATATCGCTCATGGAG
GAAGATCTGTTGATTTATCTATTTTTTCCCTTCACTTAGCTGGTATTTCTTCTATTCTAGGAGCAATTAATTTTATCACAACTATTATTAATATAC
GATTAAATAATATATCATTTGATCAATTACCTTTATTTGTATGAGCTGTAGGAATTACAGCTCTTCTTCTTCTTCTCTCTCTTCCTGTTTTAGCAG
GAGCTATTACTATATTATTAACAGATCGAAATTTAAATACTTCATTTTTTGATCCTGCAGGAGGAGGTGATCCTATTCTTTATCAACATTTATTT

Coleophora mayrella (Hübner, [1813]), CBNU201

AACATTATATTTTATTTTTGGAATTTGAGCTGGAATAGTAGGAACTTCTTTAAGTTTATTAATTCGAGCTGAATTAGGAAACCCTGGCTCTTTA
ATTGGAGATGATCAAATTTATAATACAATTGTAACAGCCCATGCTTTTATTATAATTTTTTTTATAGTTATACCTATTATAATTGGAGGTTTTG
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